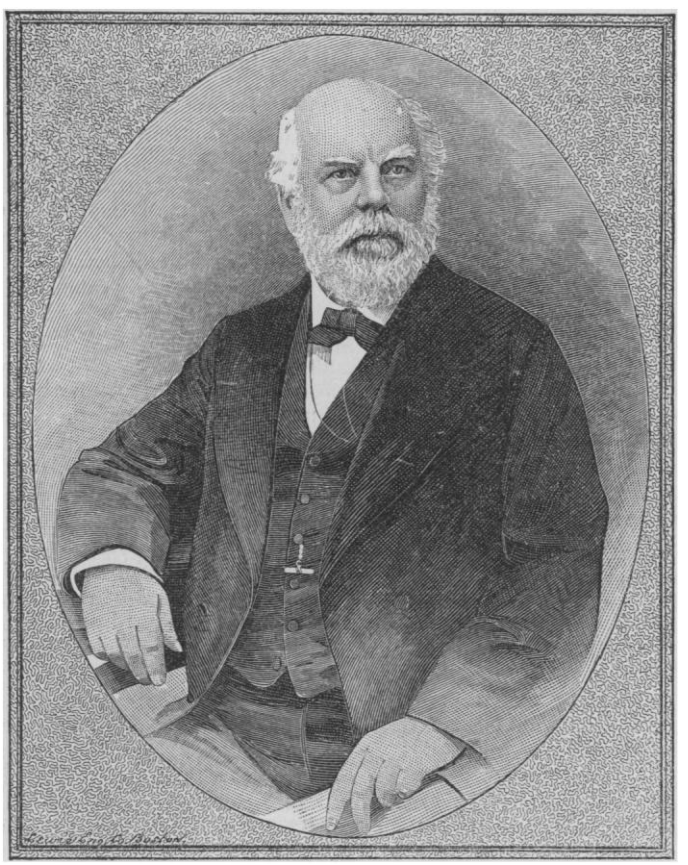
GEORGE ENGELMANN.

GEORGE ENGELMANN was born in Frankfort-on-the-Main on the 2d of February, 1809. He died in St. Louis just after the completion of his seventy-fifth year, on the 4th of February, 1884, very unexpectedly, and after an illness which had kept him from his scientific work but a few days.[1]



Dr. Engelmann received his medical education and early scientific training at Berlin, Heidelberg, and Frankfort. Agassiz, Alexander Braun, and Charles Schimper were among his college-associates and lifelong friends. His determination to establish himself in the United States must have been made early; for he left Germany almost at once after graduation, reaching New York in 1832. His first visit was to Philadelphia, attracted there by the scientific reputation of that city, where he was fortunate enough to make the acquaintance of Nuttall and other scientific men. His inclinations, however, still turned westward; and young Engelmann soon left the seaboard, to seek a home in the almost unexplored regions beyond the Mississippi. He went first to St. Louis, then scarcely more than a frontier trading-post, influenced, no doubt, in this step by the fact that there was already a little colony of Germans located there. But Dr. Engelmann did not at once establish himself in St. Louis. With the deliberation and care which characterized all the actions and studies of his life, he determined to see something of the western country before finally selecting a home. For this purpose he undertook a long and solitary journey on horse-back through southwestern Missouri, Arkansas, and western Louisiana. This journey was probably made in 1833, and occupied six months. It nearly cost Dr. Engelmann his life; for the young traveller took a dangerous fever among the Arkansas swamps, into which his botanical zeal, no doubt, often led him. Fortunately he fell into the hands of a negro family, who nursed him faithfully through his long illness, which cut short further exploration, and hurried him back to St. Louis.

Here Dr. Engelmann finally established himself as a physician in 1835. He had previously, however, gone to Germany, and on his return had brought back with him, to his new home, the faithful and devoted companion who shared his labors, his trials and triumphs, for more than forty years. From 1835 until his death Dr. Engelmann continued to live in St. Louis, and to devote to scientific investigations every moment which could be spared from a large

[1] The announcement which appeared in a previous number of this journal, that Dr. Engelmann died on the 11th of February, was erroneous: he died on the 4th of February.

and absorbing professional practice. He was able, however, to make, at long intervals, several visits to Europe (the last as recently as last year) largely for the purpose of botanical study; although his opportunities for extended botanical explorations in his adopted land only came to him late. Twice in the last ten years of his life Dr. Engelmann was able to see Colorado; in 1876, he visited the southern Alleghany Mountains; and in 1880 made a long journey through the forests of the Pacific states, where he saw for the first time, in a state of nature, plants he had studied and described more than thirty years before. Dr. Engelmann's associates in this long and arduous journey will never forget his courage and industry, his enthusiasm and zeal, his abounding good nature, and his kindness and consideration of them and every one with whom he came in contact.

Engelmann's first botanical publication appeared as long ago as 1832, when, on the eve of his departure for the United States, he printed in Latin a *dissertatio inauguralis*, 'De Antholysi prodromus,' illustrated by drawings made by the author. This paper is still sometimes referred to, and was certainly a remarkable production, in view of the youth of the writer, and the existing knowledge of vegetable morphology. No other botanical paper appeared from Dr. Engelmann's pen until 1842, when he published in the *American journal of science* his monograph of North-American Cuscutineae. He had, however, some time before, in association with Capt. C. Neyfeld, undertaken the editorship of *Das westland*, a journal printed in Heidelberg, and intended to make known to German emigrants the advantages of the Mississippi valley. This publication did not outlive the first volume, which bears upon the titlepage the date of 1837, and which contains three articles by Engelmann, generally descriptive of the natural features of the western country, with some account of his southern journey of 1833. If these early years in St. Louis were not prolific in botanical publication, their botanical occupations were not the less important and valuable. He made, at the time, large collections of western plants, then hardly, if at all, represented in European herbaria, distributing them freely among his German correspondents. At this time, too, he made the acquaintance of the authors of the 'Flora of North America,' to whom Engelmann first became known through the discoveries, by the younger of the two botanical partners in this undertaking, of some of his specimens in the Berlin herbarium. This rather roundabout introduction led to a warm friendship and close and sympathetic scientific association, which has largely shaped the botanical studies over a great continent, and which death only has interrupted.

The appearance of the monograph on Cuscutineae, which was soon republished in the *Botanische zeitung* and the *London journal of botany*, established Engelmann's reputation as a systematic botanist, and procured for him the correspondence of Hooker and other foreign botanists. Several new species are described in this paper, and the genus Lepidanche proposed for a Cuscuta-like plant of the western prairies. Cuscuta always interested Dr. Engelmann; and in 1859 he published in the Transactions of the St. Louis academy an elaborate revision of the whole genus, for which he had long been collecting material.

In 1842 he published in the *American journal of science* a list of plants collected by Charles A. Geyer in Illinois and Missouri, in which several species are first described; and in 1845, in the *Journal of the Boston society of natural history*, in collaboration with Asa Gray, an enumeration of plants collected in western Texas by his countryman, Ferdinand Lindheimer, a naturalist attached to the German colony of New Braunfels.

In 1848 was published his sketch of the botany of Dr. A. Wislizenus' expedition. Dr. Wislizenus, a German physician and a resident of St. Louis, had been attached to Col. Doniphan's expedition, but was taken prisoner by the Mexicans, and carried to Chihuahua, where, as well as in the valley of the Rio Grande, he had made important botanical collections. These were afterwards placed in Dr. Engelmann's hands for elaboration. The study of these collections exerted a powerful influence upon his subsequent botanical studies. They first drew his attention to Cactaceae and Pinus, which continued to occupy his thoughts for the remainder of his life, and of which his knowledge was unequalled. As early as 1856, Dr. Engelmann published in the Proceedings of the American academy a synopsis of the Cactaceae of the territory of the United States. Two years later appeared his 'Cactaceae of the boundary,' in the second volume of the United States and Mexican boundary survey report. This paper, superbly illustrated by drawings made (under Dr. Engelmann's direction) by Roethe, is, perhaps, his best-known botanical work. Dr. Engelmann has studied and described all the collections of Cactaceae which have from time to time been made in the Mexican boundary region, and, had he lived,

would have elaborated the whole order in accordance with his latest views of the subject. He even proposed so late as last year to pass a considerable time in northern Mexico for the purpose of studying these plants in their native country before finally giving to the world the final results of his long investigations. That he did not live long enough to elaborate the mass of material he had so industriously collected for this work is an irreparable loss to botanical science; for no other hand, in this generation at least, will be able to take up this family where he has left it.

Other difficult genera have long been studied by Dr. Engelmann. His predilections, indeed, have always been for the most difficult and perplexing plants; and he willingly devoted himself to such genera only as less patient investigators hesitated to take up. Thus he mastered the North-American Euphorbiaceae, elaborating all recent collections of the family, without, however, undertaking a complete revision of the order as represented in this country. He published an elaborate and exhaustive paper upon the North-American species of Juncus, and, later, one on the North-American Isoetes. His published notes upon the North-American species of Quercus, for years one of his most engrossing subjects, and upon North-American Abies, Juniperus, of the section Sabina, and upon the genus Pinus, contain the most valuable and trustworthy information which has appeared upon these plants. In 1873 Dr. Engelmann published, under the title of 'Notes on the genus Yucca,' his elaborate revision of the genus here first comprehensively treated. Two years later his notes on Agave appeared, in which are enumerated and described the species detected within the limits of the United States, as well as a few foreign species previously imperfectly known. Dr. Engelmann studied for many years the genus Vitis; and our knowledge of the North-American species is due in a large measure to his investigations. His last botanical publication, a sketch of the true grapevines of the United States, although written some months earlier, and previous to his last European journey, was issued late in 1883.

Dr. Engelmann's botanical writings were not voluminous. All his work, however, is characterized by the most careful and conscientious preparation, great good judgment, classical methods of treatment, and remarkable thoroughness. His investigations were slow and laborious, often lasting for years in the case of a single plant. No botanist was ever less anxious to publish prematurely the results of his observations, or was less satisfied with the extent of his own knowledge. Such admirable, and in these days unusual, caution has made Dr. Engelmann's botanical writings masterpieces in their way, worthy to stand with the best productions of their nature which have yet appeared. This very caution and desire to wait for completeness, however, which have made Dr. Engelmann's published papers what they are, have cost the world a vast store of valuable information collected by him during long years of careful investigation, but never quite ready, in his critical judgment, for publication.

Dr. Engelmann, in addition to his professional and botanical labors, was a most zealous meteorological observer, and at the time of his death was probably one of the oldest meteorologists in the United States. He published many important papers upon this and various physical and topographical subjects, but the length to which this notice is already extended precludes more than the mere mention of this fact. His meteorological and other miscellaneous papers, as well as his important botanical papers since 1859, have been published in the Transactions of the St. Louis academy of science, which he was largely instrumental in establishing, and which he long served as president.

Dr. Engelmann was a member of the American academy of arts and sciences, a corporate member of the National academy of sciences, a foreign member of the Linnaean society of London, and an active or corresponding member of many other learned bodies. His career was eminently successful. He lived to see the correctness of his judgment in selecting St. Louis as his adopted home confirmed, the frontier trading-post grown into a great city, and himself at the head of his profession there, and then his place occupied and worthily filled by his only son. He long enjoyed the friendship, the respect, and the correspondence of many of the most distinguished botanists of the age, everywhere the recognized authority in those departments of his favorite science which had most interested him.

George Engelmann, it is fair to assume, will long live in his botanical writings. The thoroughness of his work leaves little to subsequent workers in his chosen fields to gather, and secures its permanent usefulness and value. When, however, his written words are forgotten, the western plains of his adopted land will still be bright with the yellow rays of *Engelmannia;* and the splendid spruce, the fairest of them all, which bears the name of Engelmann,

will still, it is to be hoped, cover with noble forests the highest and most inaccessible slopes of the Rocky Mountains, recalling to men, as long as the study of trees occupies their thoughts, the memory of a pure, upright, and laborious life.

THE MAXIMA AND MINIMA TIDE-PREDICTING MACHINE.[1]

THIS machine has been invented by Mr. Ferrel, and constructed by Fauth & Co. of Washington, for the use of the Coast and geodetic survey. Its object is to determine mechanically the times and heights of high and low waters for the numerous tide-stations around our coast, for which tide-tables are annually published. The numerical data for these have been heretofore obtained by computation; but, on account of the great complexity of the tidal theory and formulae, this involves a great amount of labor to obtain even approximate results, and more accurate ones have to be dispensed with, unless they can be obtained in some way mechanically, with much greater facility than by computation.

The first tide-predictor was invented by Sir William Thomson, about eight years ago. This was constructed so as to take into account about ten only of the principal tide-components; all, however, which are of much practical importance. This machine has not been used in the regular prediction of tides, and is said to be now on exhibition at the South Kensington museum.

Subsequently Mr. Roberts, of the *Nautical almanac*, London, had another constructed upon somewhat the same plan, but larger, taking into account twice as many of the components, and having some improvements on the plan introduced. A description of this machine was given in *The engineer* of Oct. 19, 1879. It is now being successfully used in the prediction of the tides of India.

Both of these machines have been constructed so as to be run by clock-work, and to give the results in the form of a tide-curve for one year on a roll of paper, from which the times and heights of high and low waters are afterwards read off and recorded.

In the maxima and minima predictor, only the maxima and minima of the heights of the tide above mean low water or any other assumed plane of reference, and the times of their occurrence, are indicated; as these alone are required for the tide-tables annually published. For this purpose a transformation of the tidal harmonic function was necessary, so that it would give heights and times of the maxima and minima; and, as any such transformation usually renders the resulting expression much more complex than the original one, the whole theory and construction of this machine is much more complex than in the case in which the machine is required to give the height of the tide at regular stated intervals of time, or a graphic representation of the whole function. In this machine both the clock-work and roll of paper are dispensed with, and the machine is run by means of a small crank at the side, with the left hand; and the times and heights of high and low waters are read off from the face of the instrument, and recorded as you go, with the right hand, upon blank forms ready for the printer. The great advantage which is claimed for this form of the machine is that it gives only what is required, and this in such a way that the results can be recorded at once, and the trouble of handling long rolls of paper, and estimating the times of maxima and minima, and reading off the corresponding height of the tide, is saved. Although the machine is more complex, this makes no difference in the facility with which the results are obtained. The crank is turned until an index on the central dial of the face, called the lunar index, pointing between eight and nine on the accompanying perspective representation of the face of the instrument, comes in conjunction with the upper end of an oscillating needle, the upper end pointing between twelve and one, as represented, when the time of high water is pointed out by another index on the same dial, called the solar index, pointing, as represented, to the figure twelve, at noon and midnight, and the height is indicated by an index on a vertical scale on the left side of the face of the instrument. You then turn until the lunar index comes in conjunction with the lower end of the needle, when the solar index points out the time of low water, and the index at the side, its height. Turning until the lunar index comes in conjunction again with the upper end of the needle, you read off, as before, the times and heights of the next high water; and so on from high to low and from low to high water through the year, recording the results as you go. Where, however, there are large diurnal components, it is necessary to run through twice, — first for the times, and then, after a little change in the setting, for the heights. The machine, therefore, is especially convenient for most of the tides having a large range upon our At-

[1] This article, written by Mr. WILLIAM FERREL, is published by permission of the superintendent of the Coast and geodetic survey.